DATA SHEET

PPU 300

Paralleling and Protection Unit

4921240563O

1. Product description

1.1 About

The PPU 300 Paralleling and Protection Unit is a highly configurable controller designed for marine use. The controller contains the functions required to protect and control a generator or inverter and its breaker (specifically, a diesel generator, an inverter with battery energy storage system, a shaft generator, a shore connection, or a bus tie breaker). You can connect up to 32 controllers to create one system, with load sharing sections.

The PPU 300 can be ordered with a PLC environment (CODESYS) as an add-on option. CODESYS can be used to extend the controller functionality and/or create custom CODESYS projects for the controller.

Typically, CODESYS or an operator will send commands to the PPU 300 to close or open the breaker. CODESYS or an operator can also send commands to start or stop the generator or inverter, change the regulation mode, and change the regulation set points.

You can also use an alternative PLC to send commands to the PPU 300.

AC measurements can be configured with average filters for use on noisy or oscillating systems. This is only for the displayed values. All calculations and protections continue to use the actual values. *

The controller display unit can have push-buttons for the operator to change the controller mode, close and open the breaker, and start and stop a generator or inverter. The colour graphic screen shows status and info messages. Visual synchronisation screen shows the synchronisation state and values. The screen also allows access to live data, and alarm management. With the right authorisation, the operator can also check and/or change the input/output and parameter configuration. The light indicators of the display unit show the system status.

Each controller includes processors and high-speed internal communication. This provides fast protection functions.

The controller design is modular, and hardware modules may be replaced or added in the field.

PICUS is a proprietary, free PC software interface to the controller. The designer can use PICUS to create a flexible application diagram for the system, and configure the inputs, outputs, and parameters for all the controllers in the system. PICUS also offers system emulation, supervision, management of permissions, backups, trending, and firmware updates.

The network communication can be configured for IP address settings and for type of Ethernet port and connection node.

Engine communication with CAN bus J1939 can be configured to use an ECU to read information and alarms.

NOTE * Measurement averaging is not enabled in the default configuration. It may not be allowed for some Maritime classification approval societies.

More information
You can find additional technical documentation at https://www.deif.com/documentation/ppu-300/.

1.2 Software versions

The information in this document corresponds to the following software versions.

PPU 300 Software versions

Software	Details	Version
PCM APPL	Controller application	1.0.15.x
DU APPL	Display unit application	1.0.15.x
PICUS	PC software	1.0.15.x

1.3 Functions and features

1.3.1 General functions and features

Table 1.1 General functions for all PPU 300 controllers

	Functions
Modular and configurable design	• Compact, all-in-one controller ◦ All necessary 3-phase measurements • Optional I/O extension rack • Configurable hardware modules (printed circuit boards) ◦ Placement flexibility in the controller ◦ Remove, replace, or add on-site ◦ Automatically recognised ◦ Customisable arrangement (during ordering and/or on-site) • Configurable input and output functions (digital and analogue) ◦ Digital input functions: Commands from operators or 3rd party equipment, changing configuration, operating information ◦ Digital output functions: Alarm status, commands to 3rd party equipment, operating information ◦ Analogue input functions: External set points, operating information, supervised binary inputs ◦ Analogue output functions: Regulation *, operating information • Up to 4 sets of nominal settings ◦ Select a different set of nominal settings at any time • Configurable parameters for controller functions • Several ways to start controller sequences ◦ Automatically, display unit, digital input, PICUS, Modbus, and/or CustomLogic
Plug and play	• Automatic network configuration (uses static IPv6) • Default parameter and input-output configuration for each controller type • Automatic date and time synchronisation between all controllers in the system • NTP time synchronisation with NTP servers
Display unit	• Up to 2 display units (with interlock) per controller • Intuitive, one-touch operator-initiated sequences • 5-inch colour graphic display ◦ Initial configuration ◦ Status and info messages ◦ Live data monitoring and alarm management ◦ Visual synchronisation ◦ Configure live data screens ◦ Input, output, and parameter configuration ◦ View/configure counters

	Functions
	◦ Log, info and tools ◦ Manage backup and restore ◦ Soft keys, and virtual keyboard ◦ Context-sensitive help ◦ Configurable brightness • Supports multiple languages ◦ American English ◦ British English ◦ Chinese ◦ French ◦ German ◦ Russian ◦ Spanish
Advanced troubleshooting	• Controller hardware self-test • Event and alarm log, with real-time clock • Access to 24-hour service and support
PICUS	• Free-of-charge PC software to connect to one or more controllers • Single-line diagram tool for design, configuration and broadcast • Manage permissions and passwords (groups and users) • For each controller: ◦ Configure controller inputs, outputs, and parameters ◦ Manage alarms ◦ View status, live data, and log ◦ Manage backup and restore ◦ Use offline projects to view or edit a controller configuration ◦ Projects can be restored or broadcast. • System emulation: ◦ Safely mimic the environment that the controller connects to (loads, inputs, and failure scenarios) ◦ Test the application, get approvals, minimise site time, optimise training • System supervision • Input / output status ◦ See an overview for all input and output values for the controller, extension racks, or ECUs. • Trending ◦ Record and save operational values over a period of time ◦ Export recorded trace values to a .csv file • Manage controller and display unit software • Supports multiple controller languages
CustomLogic	• User-friendly logic configuration tool, based on ladder logic and function blocks • Up to 20 selectable input events and 20 output commands per controller • Inter-controller communication ◦ Up to 16 outputs per controller ◦ Up to 16 inputs from each controller in the system • Up to 20 Modbus signals (inputs and/or outputs) per controller
CODESYS	• Option: Extended controller functionality with soft PLC • View CODESYS license key information in PICUS or display
Communication	• Static Internet Protocol version 6 (IPv6)

	Functions
	• Configurable Internet Protocol version 4 (IPv4) • Configurable Ethernet port settings on PCM3.1 • Multi-master system. All vital data is broadcast to all controllers: ◦ Each controller performs all calculations, then acts accordingly ◦ Power management inputs and outputs may be connected to any controller ◦ Load sharing communication • DEIF internal network ◦ Controller display unit ◦ PICUS ◦ Other controllers • Internal communication ◦ Extension rack(s) • External network ◦ PICUS ◦ Modbus • Controllers connected in a ring for communication redundancy: ◦ If there is a failure: Communication path changed within 100 milliseconds. • CAN bus communication to an ECU: ◦ Generic J1939. • Authentication (other equipment cannot disrupt communication) • Password protection ◦ Customisable permission levels
Modbus	• Supports multiple Modbus protocols ◦ Standard protocol: Modbus TCP/IP ◦ Supports use and creation of custom protocols ◦ Import and export Modbus protocols • Convert data units and scaling • Configure Modbus server settings
Breaker control	• Synchronisation and breaker closing ◦ Dynamic synchronisation: With slip frequency, for fast load acceptance ◦ Static synchronisation: Phases match kept within a phase window • De-load before opening • Automatic synchronisation and de-loading • Operator-initiated synchronisation and de-loading possible • Breaker types (with configurable parameters) ◦ Pulse breaker, Compact breaker, Continuous breaker • Breaker position detection and alarms • Attempt to open breaker even with a position failure detection
Advanced blackout prevention (optional)	• Run with a closed bus tie breaker during critical operations • If a genset governor or AVR fails, the bus tie breaker trips and disconnects the genset
Redundancy	• True multi-master control • Busbar can have a ring connection • DEIF network ring connection • Internal communication ring connection • Controller commands and operation using the display unit, inputs, PICUS, and/or Modbus

	Functions
	• Redundant breaker feedback on bus tie breakers and externally controlled breakers
Additional hardware/ software features	• Hardware/software features: Power supply voltage measurement diode offset • Relay configuration (function, coil state) • Analogue input sensor failure (below and above range) • Analogue input pre-configured curves, plus up to 20 customisable curves • Analogue output pre-configured curves, plus up to 20 customisable curves • AC measurements can be configured with average filters for use on noisy or oscillating systems for displayed information. Controller data and calculations are not affected. Actual values are always used for the calculations and protections. ** ◦ No filters, or averaged values with a sample rate. • Configurable Idle run (supported engines only) ◦ Protect the engine with additional warm-up or cooldown periods • Display unit lamp test • CPU load overview ◦ Currently ◦ Average over 10 seconds ◦ Average over 1 minute ◦ Average over 10 minutes

NOTE * Only for the GENSET, and HYBRID controllers.

NOTE ** Measurement averaging is not enabled in the default configuration. It may not be allowed for some Maritime classification approval societies.

1.3.2 Alarm functions

- Pre-defined alarms, alarm actions, and alarm inhibits.
- Alarm management: Alarm state, Acknowledgement, Latching, Resetting, Shelving, Out of service.
- Customised alarm parameters: Enable, set point, delay, reset hysteresis, auto acknowledge, trigger level, suppress action.
- Three customisable inhibits per controller.
- Configurable horn output.
- Alarm test.

More information
See the chapter **Alarms** in the **Designer's handbook** for more information about alarms.

1.4 Alarms and protections

1.4.1 Alternating current (AC) protections

The controllers include the following alternating current (AC) protections, according to IEEE Std. C37.2-2008.

The protections comply with the protection functionality in IEC 61850-5 and IEC 61850-7-4, but not the communication requirements of IEC 61850. The protection names in the following tables are derived from the specification that provides the most accurate description of the protection.

The *operate time* is defined in IEV 447-05-05 (from the instant when the need for the protection arises, to when the controller output has responded). For each protection, the *operate time* is given for the minimum user-defined time delay.

AC protections for the source

Protection	IEC symbol (IEC 60617)	ANSI (IEEE C37.2)	IEC 61850	Operate time	Based on	Alarms	Note
Over-voltage	U>, U>>	59	PTOV	< 100 ms	The highest phase-to-phase (or phase-to-neutral) voltage	2	1
Under-voltage	U<, U<<	27	PTUV	< 100 ms	The lowest phase-to-phase (or phase-to-neutral) voltage	2	1
Voltage unbalance (voltage asymmetry)	UUB>	47	-	< 200 ms*	The highest difference between any of the 3 phase-to-phase (or phase-to-neutral) voltage true RMS values, and the average value	1	1
Negative sequence voltage		47	PNSC	< 200 ms*	The estimated phase-to-neutral voltage phasors	1	2
Zero sequence voltage		59Uo	PZOV	< 200 ms*	The estimated phase-to-neutral voltage phasors	1	2
Over-current	3I>, 3I>>	50TD	PTOC	< 100 ms	The highest phase current true RMS values	2	1
Fast over-current (short circuit)	3I>>>	50/50TD	PIOC	< 50 ms	The highest phase current true RMS values	2	1
Current unbalance	IUB>	46	-	< 200 ms*	The highest difference between any of the 3 phase currents and the average, or nominal value	2	1
Inverse time over-current	It>	51	PTOC	-	The highest phase current true RMS values, based on IEC 60255 part 151	1	1
Directional over-current		67	PTOC	< 100 ms	The highest phase current true RMS value, with the direction from the active power	2	2
Negative sequence current		46	PUBC	< 200 ms*	The estimated phase-to-neutral current phasors	1	3
Zero sequence current		51Io	PTOC	< 200 ms*	The estimated phase-to-neutral current phasors	1	3
Over-frequency	f>, f>>	81O	PTOF	< 100 ms	The lowest fundamental frequency of a phase voltage	2	1
Under-frequency	f<, f<<	81U	PTUF	< 100 ms	The highest fundamental frequency of a phase voltage	2	1
Overload	P>, P>>	32	PDOP	< 100 ms	The active power (all phases)	2	1
Reverse power	P<, P<<	32R	PDRP	< 100 ms	The active power (all phases)	2	4
Overload reverse power		32R		< 100 ms	The active power (all phases)	2	6
Over-excitation (reactive power export)	Q>, Q>>	40O	POEX	< 100 ms	The reactive power (all phases)	2	1
Under-excitation (reactive power import/loss of excitation)	Q<, Q<<	40U	PUEX	< 100 ms	The reactive power (all phases)	2	1

Protection	IEC symbol (IEC 60617)	ANSI (IEEE C37.2)	IEC 61850	Operate time	Based on	Alarms	Note
Synchronisation check (including blackout close)	-	25	RSYN	-	The frequency difference, the voltage difference, and the phase angle across the breaker	Not an alarm	1
Stabilized differential current protection (ACM3.2 differential current module required)	Id>	87G	PDIF	< 40ms (When the measured value increases from zero to two times the alarm set point)	The RMS value of the fundamental frequency part of the sum/difference of the neutral side and consumer side currents, dependent on the operating characteristic Operate value accuracy: Based on the largest secondary current • $I_{secondary}$ ≤ 20 A: 1.5 % of $I_{secondary}$ or ±15 mA • 20 A < $I_{secondary}$ ≤ 250 A: 2.5 % of $I_{secondary}$	1	5
High set differential current protection (ACM3.2 differential current module required)	Id>>	87G	PDIF	< 40 ms (When the measured value increases from zero to two times the alarm set point)	The RMS value of the fundamental frequency part of the sum/difference of the neutral side and consumer side currents, independent of the restraint current Operate value accuracy: Based on the largest secondary current • $I_{secondary}$ ≤ 20 A: 1.5 % of $I_{secondary}$ or ±15 mA • 20 A < $I_{secondary}$ ≤ 250 A: 2.5 % of $I_{secondary}$	1	5

Note 1: All controller types.

Note 2: Only GENSET and HYBRID controller.

Note 3: Only GENSET, HYBRID and BUS TIE breaker controllers.

Note 4: Only GENSET, HYBRID, SHAFT generator and SHORE connection controllers.

Note 5: Only GENSET and SHAFT generator controllers with ACM3.2 installed.

Note 6: Only HYBRID controllers for overload protection.

NOTE * These operate times include the minimum user-defined delay of 100 ms.

AC protections for the busbar

Protection	IEC symbol (IEC 60617)	ANSI (IEEE C37.2)	IEC 61850	Operate time	Based on	Alarms	Note
Over-voltage	U>, U>>	59	PTOV	< 50 ms	The highest phase-to-neutral (or phase-to-phase) voltage	2	1
Under-voltage	U<, U<<	27	PTUV	< 50 ms	The lowest phase-to-neutral (or phase-to-phase) voltage	2	1
Voltage unbalance (voltage asymmetry)	UUB>	47	-	< 200 ms*	The highest difference between any of the 3 phase-to-phase (or phase-to-neutral) voltage true RMS values, and the average value	1	1
Over-frequency	f>, f>>	81O	PTOF	< 50 ms	The lowest fundamental frequency of a phase voltage	2	1
Under-frequency	f<, f<<	81U	PTUF	< 50 ms	The highest fundamental frequency of a phase voltage	2	1

Note 1: All controller types.

NOTE * This operate time includes the minimum user-defined delay of 100 ms.

Other AC protections

Protection	IEC symbol (IEC 60617)	ANSI (IEEE C37.2)	IEC 61850	Operate time	Based on	Alarms
Lockout relay		86		-	Protected equipment	1
Earth inverse time over-current*		51G		-	The earth current true RMS value, measured by the 4th current measurement on ACM3.1, filtered to attenuate the third harmonic (at least 18 dB)	1
Neutral inverse time over-current*		51N		-	The neutral current true RMS value, measured by the 4th current measurement on ACM3.1	1

NOTE * These alarms are both based on the same measurement hardware. Therefore you can only use one of these alarms at a time.

1.4.2 General controller alarms

All controllers

Each controller includes the AC protections, the alarms listed here, and the alarms specific to the controller type.

[*B] refers to the breaker that the controller controls. For example, GB for a GENSET controller.

represents a number that is related to that type of alarm.

	Protections	Alarms
Breaker	[*B] closing failure	1*
	[*B] opening failure	1*
	[*B] position failure	1*
	[*B] configuration failure	1*
	[*B] synchronisation failure	1*
	[*B] de-load failure	1*
	[*B] tripped (external)	1*
	[*B] short circuit	1*
	[*B] vector mismatch alarm	1*
Communication	Modbus communication timeout	1
	DEIF network redundancy broken	1
	DEIF network top ring redundancy broken	1
	No NTP server time synchronisation	1
	No NTP server(s) connected	1
	NTP server # could not connect	2
	NTP server # is not responding	2
	Fieldbus conflict	1
	Fieldbus connection missing	1
	ECU communication failure	1
Synchronisation	Phase sequence error [Source]	1
	Phase sequence error [Busbar]	1
System monitoring	Breaker # feedback position failure	1
	Live power detected (Emulation)	1
	Emulation disabled (Live power)	1
	Application initialisation error	1
	Controller not part of system	1
	Single-line missing/none active	1
	Missing any controller	1
	Missing all controllers	1
	Missing controllers	1
	System not OK	1
	Critical process error	1
	Different single-line configurations	1
	Controller type mismatch	1
	Controller ID not configured	1
	Duplicate controller ID	1
	Missing controller ID #	1 for each controller (up to 12)
	Configuration update delayed	1

	Protections	Alarms
Inputs	Digital inputs	Up to 50 customisable alarms per controller
	Analogue inputs	Up to 200 customisable alarms per controller
General	PSM3.1 # supply voltage high	1
	PSM3.1 # supply voltage low	1
	PCM clock battery failure	1
	Controller temperature too high	1
	Required I/O card(s) not found	1
	Software mismatch on hardware module(s)	1

Table 1.2 ACM measurement error protections

	Protections
ACM measurement error	[Source] L1-L2-L3 wire break *
	[Busbar] L1-L2-L3 wire break *
	[Source] L1 wire break *
	[Source] L2 wire break *
	[Source] L3 wire break *
	[Busbar] L1 wire break *
	[Busbar] L2 wire break *
	[Busbar] L3 wire break *
	ACM 1 protections not running
	ACM 1 data is missing

NOTE * These alarms only work when the breaker is closed. These alarms are only on GENSET, SHAFT generator, SHORE connection, and BUS TIE breaker controllers.

The following table shows the names for [Source] and [Busbar] for the controllers with ACM measurement error protections.

Controller type	[Source]	[Busbar]
GENSET	Generator	Busbar
HYBRID	Inverter	Busbar
SHAFT generator	Generator	Busbar
SHORE connection	Shore busbar	Ship busbar
BUS TIE breaker	Busbar A	Busbar B

Optional hardware

Table 1.3 Alarms for the EIM3.1 hardware (optional)

	Protections	Alarms
Power supply	EIM3.1 # supply voltage high	1
	EIM3.1 # supply voltage low or missing	1
Wire break	EIM3.1 # relay 4 wire break	1
Standalone **	EIM3.1 # hardware revision does not support stand-alone	1

	Protections	Alarms
Safety shutdown	EIM3.1 # safety shutdown configuration is not correct	1
	EIM3.1 # safety shutdown still has control	1

NOTE ** Standalone is only available on the first installed EIM3.1 hardware module.

Table 1.4 Alarms for the GAM3.2 hardware (optional)

	Protections	Alarms
General	GAM3.2 # status not OK	1
	GAM3.2 # supply voltage high	1
	GAM3.2 # supply voltage low or missing	1

Table 1.5 Alarms for the extension rack (optional)

	Protections	Alarms
General	PSM3.2 # status not OK	1
	PSM3.2 # supply voltage high	1
	PSM3.2 # supply voltage low	1

2. Controller types

2.1 About the controller types

Each controller is assigned a type from the factory. This can be changed from the Single-line application drawing for the associated controller ID. *

Controller type	Controls and protects
GENSET controller	An engine and generator, and the generator breaker.
HYBRID controller	An inverter with storage system, and the inverter breaker
BUS TIE breaker controller	One bus tie breaker.
SHAFT generator controller	The system when a shaft generator is connected.
SHORE connection controller	The system and the shore connection breaker, when a shore connection is connected.

*** Restrictions on change of controller type**

Controller type changes are restricted, depending on the initial controller type:

- GENSET controllers can be changed to any PPU 300 controller type.
- SHAFT generator, SHORE connection and BUS TIE breaker controllers can only be changed to one of these three controller types.

2.2 About the controller or extension racks

A rack is an aluminium box that houses the hardware modules. The rack is used for both controllers and for the extension of input/outputs with additional hardware modules.

It comes in two sizes:

- Rack 4.1 (holds four modules)
- Rack 7.1 (holds seven modules)

The hardware modules in the rack communicate through the rack backplane. For cable organisation, each rack includes two cable strain relief plates (top and bottom) and a number of cable tie slots.

2.3 About the display unit DU 300

The controller can run with or without a display, but we recommend to use the DU 300 display unit. Alternatively, you can use a touch display from the DEIF AGI 400 series.

The display unit is the operator's interface to the controller. The 5-inch colour graphic display shows real-time operating information, and it supports all languages with UTF-8 fonts.

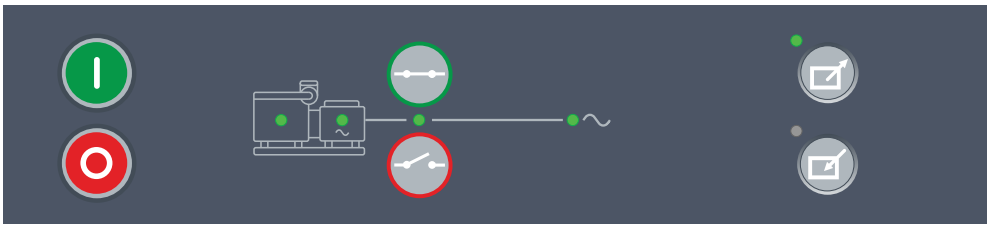
The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design).

1. Top part
   - Same for all DU 300 display units
2. Bottom strip with control
   - Different for each controller type (shown for GENSET controller)

2.4 GENSET controller

A system can include a number of GENSET controllers that work together to ensure effective power management. Each controller can connect up to three non-essential load groups (NEL).

PPU 300 Display unit bottom strip with control (DG + CB CTRL)



2.4.1 Functions

Functions

	Functions
Pre-programmed sequences	• Genset start and stop sequences • Breaker sequences • Generator breaker blackout close
Regulation	• PID regulators for analogue outputs • P regulators for relay outputs • Set point selection using digital input, Modbus, and/or CustomLogic or CODESYS • Governor: ◦ Active power load sharing ◦ Fixed frequency ◦ Fixed active power ◦ Frequency droop • AVR: ◦ Reactive power load sharing ◦ Fixed voltage ◦ Fixed reactive power ◦ Fixed cos phi

	Functions
	◦ Voltage droop • External set point from analogue input or Modbus • Configurable power ramp up/down • Three sets of temperature-dependent power derate settings
4th current	• Measurement for earth or neutral protections
Control modes	• Local mode: ◦ Generator start/stop with the start/stop push-buttons ◦ The breaker is controlled by the close/open push-buttons • Remote mode: ◦ Generator and breaker controlled from a PLC (or integrated CODESYS) combined with parameter settings

2.4.2 Alarms and protections

These alarms are in addition to the AC protections and general alarms for PPU 300 controllers.

	Alarms and protections
Engine	Emergency stop
	Overspeed (2 alarms)
	Under-speed (2 alarms)
	Crank failure
	Primary running feedback failure
	Start failure
	Stop failure
	Engine stop (external)
	Engine start (external)
	Start enable removed during start
	Total running hours notification
	Trip running hours notification
	Magnetic pickup wire break
Generator	Voltage or frequency not OK
Regulation	GOV regulation error
	GOV regulation mode not selected
	GOV stand-alone configuration error*
	GOV relay setup incomplete
	P load sharing failure
	AVR regulation error
	AVR regulation mode not selected
	AVR stand-alone configuration error*
	AVR relay setup incomplete
	Q load sharing failure

	Alarms and protections
Non-essential load (NEL)	• Up to 3 non-essential loads per controller • Can connect each controller to the same 3 non-essential load breakers
	NEL # over-current (1 alarm for each non-essential load)
	NEL # under-frequency (1 alarm for each non-essential load)
	NEL # overload 1 and 2 (2 alarms for each non-essential load)
	NEL # reactive overload (1 alarm for each non-essential load)
Other	Trip AVR output not configured

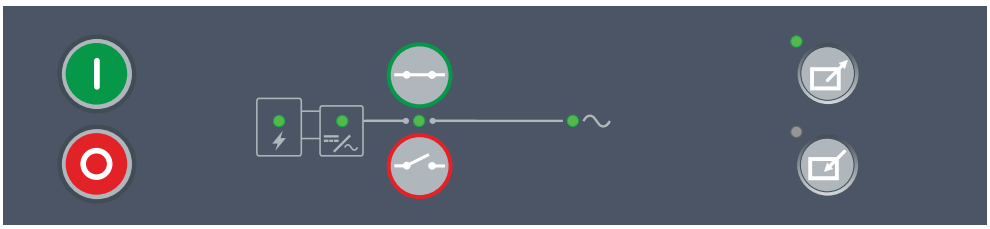
NOTE * Only in GAM3.2.

2.5 HYBRID controller

A HYBRID controller controls an inverter with battery storage, and the inverter breaker. A system can include a number of HYBRID controllers.

Each HYBRID controller can connect up to three non-essential load groups (NEL).

PPU 300 Display unit bottom strip



2.5.1 Functions

Functions

	Functions
Pre-programmed sequences	• Inverter start and stop sequences • Breaker sequences • Inverter breaker blackout close
Inverter modes	• Power Take Off (PTO) • Power Take In (PTI) • Standby
Counters	• Display unit counters, to edit or reset: ◦ Start attempts ◦ Running hours (total and trip) ◦ Inverter breaker operations and trips ◦ Power export (active and reactive) ◦ External breaker operations • Energy counters with configurable digital outputs for external counters
Control modes	• Local mode: ◦ Inverter start/stop with the start/stop push-buttons ◦ The breaker is controlled by the close/open push-buttons • Remote mode:

	Functions
	◦ Inverter and breaker controlled from a PLC (or integrated CODESYS) combined with parameter settings

2.5.2 Alarms and protections

These alarms are in addition to the AC protections and general alarms for PPU 300 controllers.

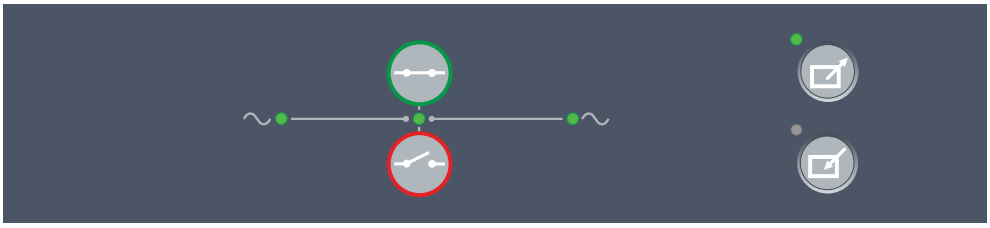
	Alarms and protections
Inverter	Emergency stop
	Start sequence failure
	Stop sequence failure
	Total running hours notification
	Trip running hours notification
	Standby request failure
	Standby acknowledge timeout
	PTI request failure
	PTI acknowledge failure
	PTO request failure
	PTO acknowledge failure
Regulation	GOV regulation error
	GOV regulation mode not selected
	GOV stand-alone configuration error *
	GOV relay setup incomplete
	P load sharing failure
	AVR regulation error
	AVR regulation mode not selected
	AVR stand-alone configuration error *
	AVR relay setup incomplete
	Q load sharing failure
Maximum parallel time	Hybrid-SG max. parallel time
	Hybrid-SC max. parallel time
Non-essential load (NEL)	• Up to 3 non-essential loads per controller • Can connect each controller to the same 3 non-essential load breakers
	NEL # over-current (1 alarm for each non-essential load)
	NEL # under-frequency (1 alarm for each non-essential load)
	NEL # overload 1 and 2 (2 alarms for each non-essential load)
	NEL # reactive overload (1 alarm for each non-essential load)
Other	Trip AVR output not configured

NOTE * Only in GAM3.2.

2.6 BUS TIE breaker controller

There is no restriction on the number of BUS TIE breaker controllers. Ring busbar connection is possible.

PPU 300 Display unit bottom strip with control (CB CTRL)



2.6.1 Functions

Functions

	Functions
Synchronisation and deloading	• Broadcast the set point for GENSET controllers (busbar A and busbar B sections)
Counters	• Display unit counters, to edit or reset: ◦ Bus tie breaker operations and trips ◦ Busbar B energy export/import (active and reactive) ◦ Energy differential (active and reactive) ◦ External breaker operations • Energy counters with configurable digital outputs (for external counters)

2.6.2 Alarms and protections

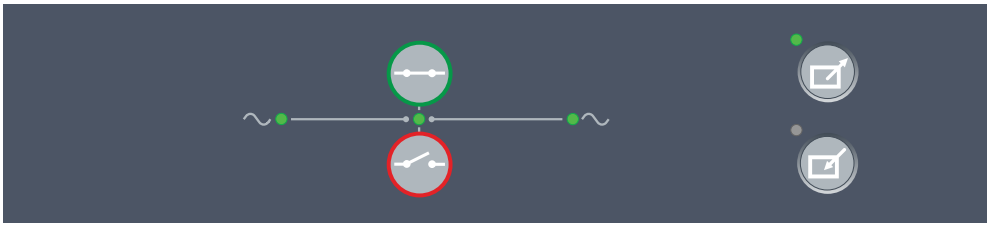
All the BUS TIE breaker controller alarms are included in the AC protections and general alarms for PPU 300 controllers.

2.7 SHAFT generator controller

When the shaft generator is connected, it is normally the ship's only power source. However, it is possible for the shaft generator to run in parallel with the gensets and supply a base load for an extended period (long-time parallel).

There is no restriction on the number of SHAFT generator controllers.

PPU 300 Display unit bottom strip with control (CB CTRL)



2.7.1 Functions

Functions

	Functions
Running detection	• Multiple feedback options: Frequency, MPU/W/NPN/PNP (RPM), Digital input
Synchronisation and deloading	• Broadcast the set point for GENSET controllers
Counters	• Display unit counters, to edit or reset: ◦ Running hours (total, and trip) ◦ Shaft generator breaker operations and trips ◦ Energy export/import (active and reactive) ◦ External breaker operations • Energy counters with configurable digital outputs for external counters
Regulation	• Regulators for relay outputs and analogue outputs • Governor regulation: ◦ Fixed power ◦ Active power load sharing ◦ Active power ramp down ◦ Frequency-dependent power droop • AVR regulation: ◦ Reactive power load sharing ◦ Fixed reactive power ◦ Fixed cos phi ◦ Voltage droop • Configurable power ramp up/down

2.7.2 Alarms and protections

These alarms are in addition to the AC protections and general alarms for PPU 300 controllers.

	Alarms and protections
Running feedback	Primary running feedback failure
Maximum parallel time	SG-DG maximum parallel time
	SG-SG maximum parallel time
	SG-Hybrid maximum parallel time
Regulation	• GOV regulation error • GOV regulation mode not selected • GOV stand-alone configuration error * • P load sharing failure • AVR regulation error • AVR regulation mode not selected • AVR stand-alone configuration error * • Q load sharing failure

	Alarms and protections
Non-essential load (NEL)	• Up to 3 non-essential loads per controller • Can connect each controller to the same 3 non-essential load breakers
	NEL # over-current (1 alarm for each non-essential load)
	NEL # under-frequency (1 alarm for each non-essential load)
	NEL # overload 1 and 2 (2 alarms for each non-essential load)
	NEL # reactive overload (1 alarm for each non-essential load)
Other	Trip AVR output not configured

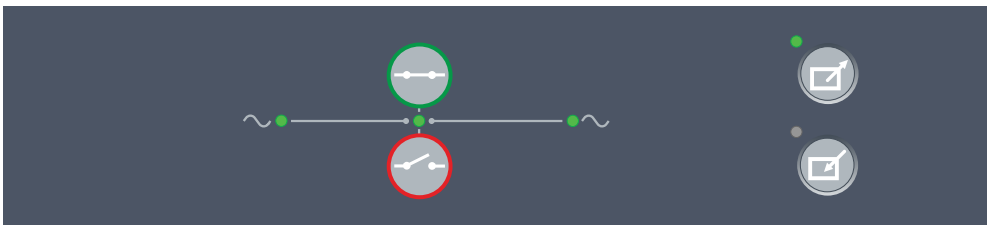
NOTE * Only in GAM3.2.

2.8 SHORE connection controller

When the shore connection is in use, it is normally the ship's only power source. However, the gensets may run in parallel with the shore connection for a limited time.

There is no restriction on the number of SHORE connection controllers.

PPU 300 Display unit bottom strip with control (CB CTRL)



2.8.1 Functions

Functions

	Functions
Synchronisation and deloading	• Broadcast the set point for GENSET controllers
Counters	• Display unit counters, to edit or reset: ◦ Shore connection breaker operations and trips ◦ Power export/import (active and reactive) ◦ External breaker operations • Energy counters with configurable digital outputs for external counters

2.8.2 Alarms and protections

These alarms are in addition to the AC protections and general alarms for PPU 300 controllers.

	Alarms and protections
Maximum parallel time	SC-DG maximum parallel time
	SC-SC maximum parallel time
	SC-SG maximum parallel time
	SC-Hybrid maximum parallel time
Non-essential load (NEL)	• Up to 3 non-essential loads per controller

	Alarms and protections
	• Can connect each controller to the same 3 non-essential load breakers
	NEL # over-current (1 alarm for each non-essential load)
	NEL # under-frequency (1 alarm for each non-essential load)
	NEL # overload 1 and 2 (2 alarms for each non-essential load)
	NEL # reactive overload (1 alarm for each non-essential load)

3. Technical specifications

The general technical specifications apply to all hardware. Refer to the other sections for the specific technical specifications for specific hardware.

The specifications and approvals apply to the rack with all the hardware modules properly installed.

3.1 General technical specifications

3.1.1 Electrical specifications

Category	Specification
Safety	EN 61010-1, CAT III, 600V, pollution degree 2 IEC/EN 60255-27, CAT III, 600V, pollution degree 2 UL508 UL6200 CSA C22.2 No. 14-13 CSA C22.2 No. 142 M1987
Electromagnetic compatibility (EMC)	EN 61000-6-3 Residential, commercial and light-industrial environments EN 61000-6-2 Industrial environments IEC/EN 60255-26 IEC 60533 power distribution zone IACS UR E10 power distribution zone for controller rack IEC 60945 for display unit
Load dump	ISO 7637-2 pulse 5a

3.1.2 Mechanical specifications

Category	Specification	
Vibration	Operation	3 to 8 Hz: 17 mm peak-to-peak 8 to 100 Hz: 4 *g* 100 to 500 Hz: 2 *g*
	Response	10 to 58.1 Hz: 0.15 mm peak-to-peak 58.1 to 150 Hz: 1 *g*
	Endurance	58 to 150 Hz: 2 *g*
	Seismic	3 to 8.15 Hz: 15 mm peak-to-peak 8.15 to 35 Hz: 2 *g*
	IEC 60068-2-6, IACS UR E10, IEC 60255-21-1 (class 2), IEC 60255-21-3 (class 2)	
Shock (base mounted)	10 *g*, 11 ms, half sine IEC 60255-21-2 Response (class 2) 30 *g*, 11 ms, half sine IEC 60255-21-2 Endurance (class 2) 50 *g*, 11 ms, half sine IEC 60068-2-27	
Bump	20 *g*, 16 ms, half sine IEC 60255-21-2 (class 2)	
Material	All plastic materials are self-extinguishing according to UL94 (V0)	

NOTE *g* = gravitational force (g-force).

3.1.3 Environment specifications

Category	Specification
Humidity	97 % relative humidity condensing, to IEC 60068-2-30
Operating temperature, rack and modules	-40 to 70 °C (-40 to 158 °F) UL/cUL Listed: maximum surrounding air temperature: 55 °C (131 °F)
Operating temperature, display unit	-20 to 70 °C (-4 to 158 °F) UL/cUL Listed: maximum surrounding air temperature: 55 °C (131 °F)
Storage temperature, rack and modules	-40 to 80 °C (-40 to 176 °F)
Storage temperature, display unit	-30 to 80 °C (-22 to 176 °F)
Operating altitude	Up to 4,000 m (13,123 ft) Refer to the module specifications for information on altitude derating over 2,000 m (6,562 ft)

3.1.4 Approvals

These approvals apply to the controller rack (with all the modules properly installed), and to the display unit.

Standards
CE
UL/cUL Listed to UL508 - Industrial Control Equipment, and CSA C22.2 No. 142 M1987 - Process Control Equipment
UL/cUL Recognised to UL6200 - Controls for stationary engine driven assemblies, and CSA C22.2 No. 14-13 - Industrial Control Equipment

NOTE For marine approvals, refer to www.deif.com for the most recent approvals.

3.2 Rack specifications

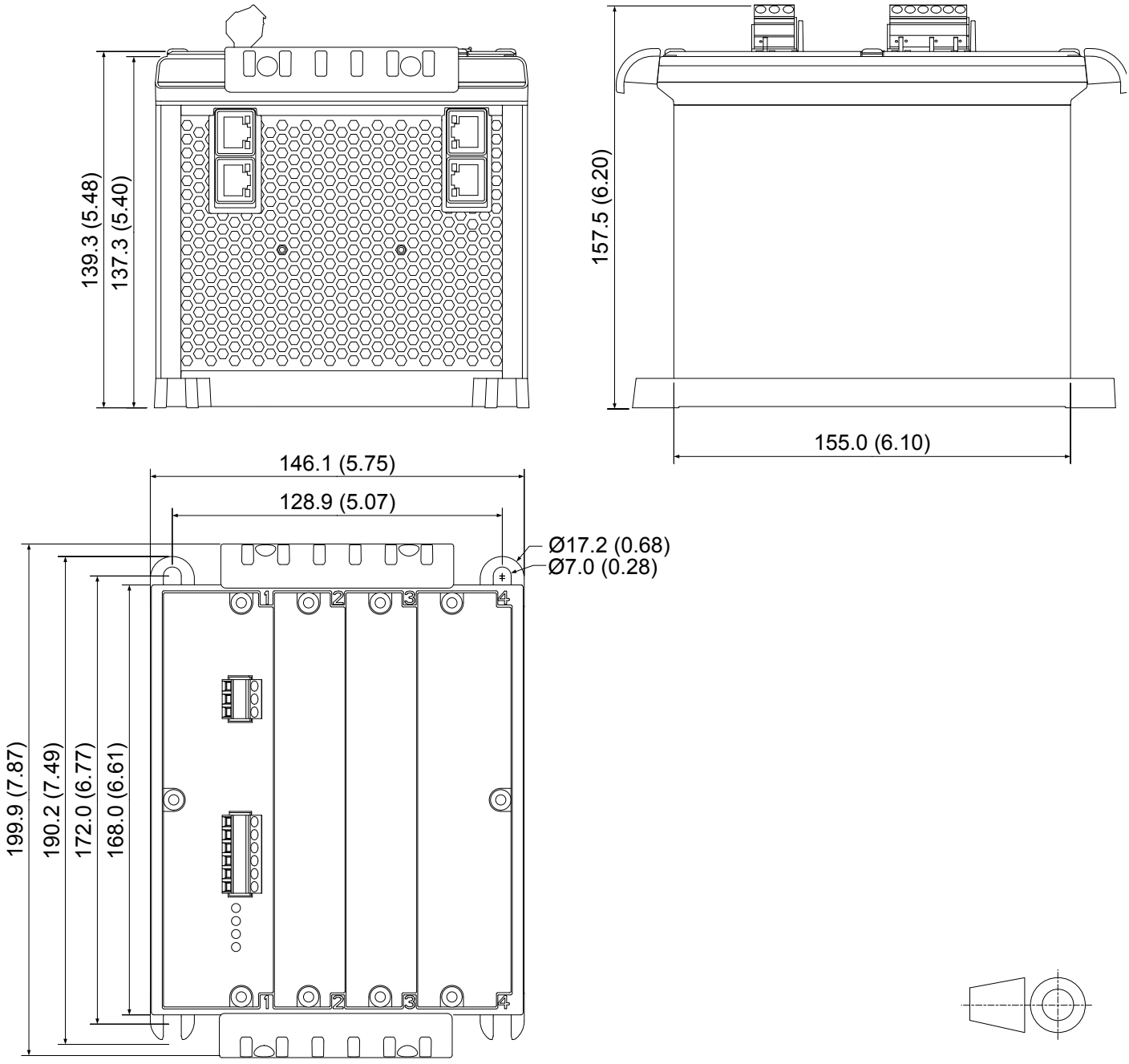
3.2.1 Rack R4.1

Rack R4.1 technical specifications

Category	Specification
Ingress protection	IP20 (all slots must have modules or blind modules mounted) according to IEC/EN 60529
UL/cUL Listed	Type Complete Device, Open Type 1
Material	Rack frame: Aluminium
Mounting	Base mount, using four M6 bolts with self-locking washers (or self-locking screws). The bolts and self-locking washers (or self-locking screws) are not included with the rack. UL/cUL Listed: For use on a flat surface of a type 1 enclosure UL/cUL Listed: To be installed in accordance with the NEC (US) or the CEC (Canada)
Tightening torque	Mounting bolts: 4 N·m (35 lb-in)

Rack 4.1 dimension and weight specifications

Category	Specification
Size	L 146.1 mm x H 199.9 mm x D 157.5 mm (5.75 in x 7.87 in x 6.20 in) (outer frame, includes cable strain relief plates)
Weight	Without any hardware modules: 994 g (2.2 lb)



3.2.2 Rack R7.1

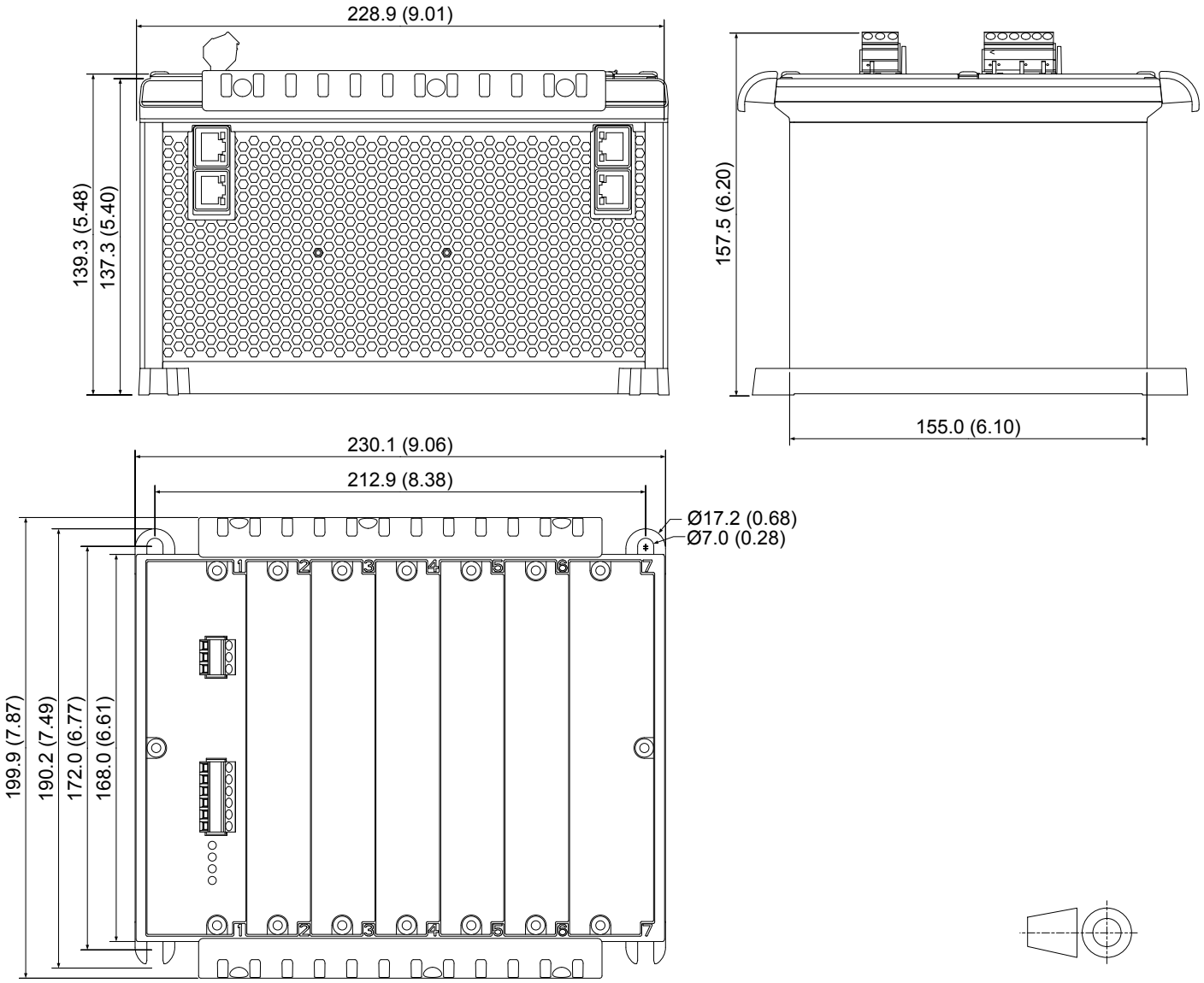
Rack 7.1 technical specifications

Category	Specification
Ingress protection	IP20 (all slots must have modules or blind modules mounted) according to IEC/EN 60529
UL/cUL Listed	Type Complete Device, Open Type 1

Category	Specification
Material	Rack frame: Aluminium
Mounting	Base mount, using four M6 bolts with self-locking washers (or self-locking screws). The bolts and self-locking washers (or self-locking screws) are not included with the rack. UL/cUL Listed: For use on a flat surface of a type 1 enclosure UL/cUL Listed: To be installed in accordance with the NEC (US) or the CEC (Canada)
Tightening torque	Mounting bolts: 4 N·m (35 lb-in)

Rack 7.1 dimensions and weight specifications

Category	Specification
Size	L 230.1 mm x H 199.9 mm x D 157.5 mm (9.06 in x 7.87 in x 6.20 in) (outer frame, includes cable strain relief plates)
Weight	Without any hardware modules: 1330 g (2.9 lb)



3.3 Hardware module specifications

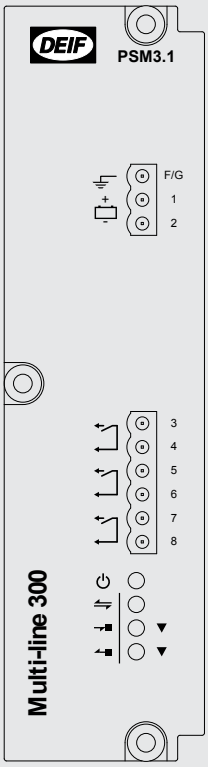
3.3.1 Power supply module PSM3.1 (Controller)

The power supply module provides power to all hardware modules in the rack. The rack status and alarms activate the three relay outputs. There are two ports for internal communication with extension racks.

The PSM3.1 must to be powered by a power supply with Power Boost function.

The PSM3.1 manages the hardware module self-checks for the rack and includes a power LED. The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

PSM3.1 terminals

Module	Count	Symbol	Type/Info	Name
	1		Ground	Frame ground
	1		12 or 24 V	Power supply
	3		Relay output	1 × Status OK (fixed) 2 × configurable
	1		**Off** : No power supply	Power supply indication
			Red flash : PSM is starting	
			Green : Power supply	
			Green flash : Controller identification	
	1		**Off** : No internal communication	Internal communication connections (to connect to extension racks). LEDs are on the module front, connections are at the module bottom.
			Green : Internal Communication	
	1		Internal communication (RJ45) input	
			Off : No communication	
			Green : Communication connected	
			Green flash : Active communication	
	1		Internal communication (RJ45) output	
			Off : No communication	
			Green : Communication connected	
			Green flash : Active communication	

PSM3.1 technical specifications

Category	Specification
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Controller power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 20 W, maximum 35 W Voltage measurement accuracy: 0 to 30 V: ±1 V; 30 to 36 V: +1/-2 V Internal protection: 12 A fuse (not replaceable) (fuse size determined by load dump requirements)

Category	Specification
	Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter ◦ 24 V: 4 A minimum ◦ 12 V: 8 A minimum • Battery: No limit
Relay outputs 	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Terminal connections	**Frame ground and power supply**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Communication connections	Internal communication: RJ45. Use an Ethernet cable that meets or exceeds the SF/UTP CAT5e specifications
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply and other I/Os: 600 V, 50 Hz for 60 s Between relay groups and other I/Os: 600 V, 50 Hz for 60 s Between internal communication ports and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 43.3 × 162 × 150 mm (1.5 × 6.4 × 5.9 in)
Weight	331 g (0.7 lb)

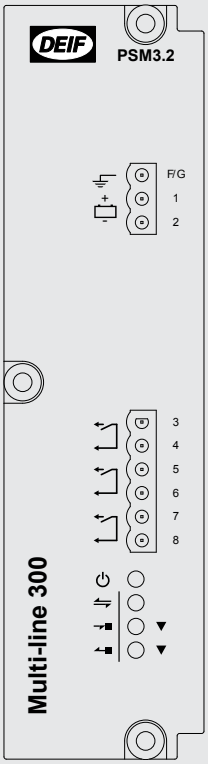
3.3.2 Power supply module PSM3.2 (Extension)

The power supply module provides power to all hardware modules in the extension rack and communicates with the main controller through the internal communication ports. The rack status and alarms activate the three relay outputs. There are two ports for internal communication with the main controller.

The PSM3.2 must to be powered by a power supply with Power Boost function.

The PSM3.2 manages the hardware module self-checks for the rack and includes a power LED. The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

PSM3.2 terminals

Module	Count	Symbol	Type/Info	Name
	1		Ground	Frame ground
	1		12 or 24 V	Power supply
	3		Relay output	1 × Status OK (fixed) 2 × configurable
	1		**Off** : No power supply	Power supply indication
			Red flash : PSM is starting	
			Green : Power supply	
			Green flash : Rack identification	
	1		**Off** : No internal communication	Internal communication connections (to connect to the racks). LEDs are on the module front, connections are at the module bottom.
			Green : Internal Communication	
	1		Internal communication (RJ45) input	
			Off : No communication	
			Green : Communication connected	
			Green flash : Active communication	
	1		Internal communication (RJ45) output	
			Off : No communication	
			Green : Communication connected	
			Green flash : Active communication	

PSM3.2 technical specifications

Category	Specification
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Controller power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 20 W, maximum 35 W Voltage measurement accuracy: 0 to 30 V: ±1 V; 30 to 36 V: +1/-2 V Internal protection: 12 A fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter ◦ 24 V: 4 A minimum ◦ 12 V: 8 A minimum • Battery: No limit
Relay outputs	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Terminal connections	**Frame ground and power supply**:

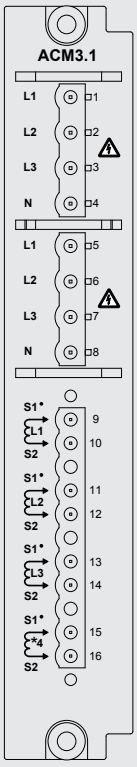
Category	Specification
	• Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections**: • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Communication connections	Internal communication: RJ45. Use an Ethernet cable that meets or exceeds the SF/UTP CAT5e specifications
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply and other I/Os: 600 V, 50 Hz for 60 s Between relay groups and other I/Os: 600 V, 50 Hz for 60 s Between internal communication ports and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 43.3 × 162 × 150 mm (1.5 × 6.4 × 5.9 in)
Weight	331 g (0.7 lb)

3.3.3 Alternating current module ACM3.1

The alternating current module ACM3.1 measures the voltage and current on one side of a breaker, and the voltage on the other side. The hardware module responds when the measurements exceed the AC alarm parameters.

ACM3.1 provides robust frequency detection in environments with electrical noise. ACM3.1 allows extended measurement bandwidth up to 40 times the nominal frequency. ACM3.1 includes a configurable 4th current measurement.

ACM3.1 terminals

Module	Count	Symbol	Type	Name
	2 × (L1, L2, L3 and N)	L1/L2/L3/N	Voltage	3-phase voltage measurements
	1 × (L1, L2, L3 and 4th)		Current	3-phase current measurement 4th current measurement

ACM3.1 technical specifications

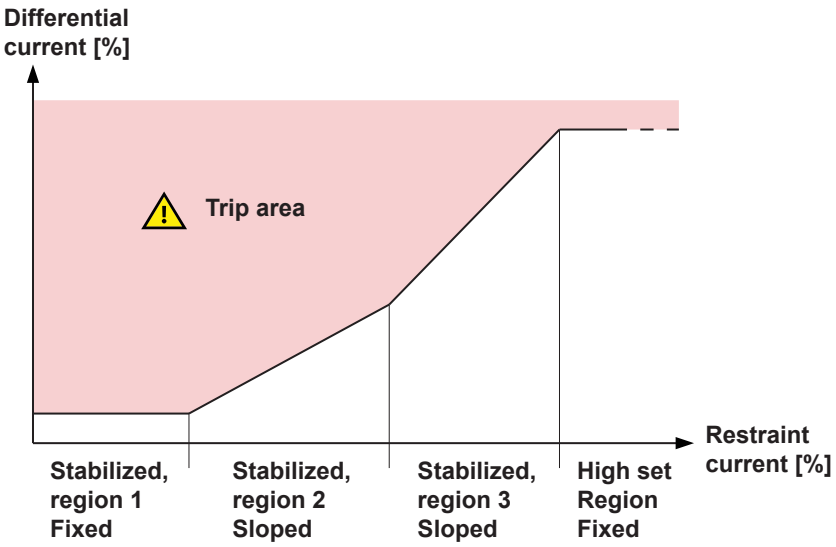
Category	Specification
Voltage measurements	Nominal value: 100 to 690 V AC phase-to-phase Measurement range: 2 to 897 V AC phase-to-phase Accuracy: Class 0.2 Phase angle accuracy: 0.1° (within nominal voltage range and nominal frequency range) Altitude derating from 2,000 to 4,000 m (6,562 to 13,123 ft): 100 to 480 V AC phase-to-phase UL/cUL Listed: 100 to 600 V AC phase-to-phase Load on external voltage transformer: Maximum 0.2 VA/phase Voltage withstand: 1.2 × Nominal voltage continuously; 1.3 × Nominal voltage for 10 s
Current measurements	Nominal value: 1 or 5 A AC from current transformer Measurement range: 0.02 to 17.5 A AC from current transformer; Truncation level: 11 mA Accuracy: Class 0.2 Earth current: 18 dB attenuation of third harmonic of the nominal frequency UL/cUL Listed: From listed or R/C (XODW2.8) current transformers 1 or 5 A Load on external current transformer: Maximum 0.3 VA/phase Current withstand: 10 A continuously; 17.5 A for 60 s; 100 A for 10 s; 250 A for 1 s
Frequency measurements	Nominal value: 50 Hz or 60 Hz Measurement range: 35 to 78 Hz Accuracy: Class 0.1 of nominal value (35 to 78 Hz) (-40 to 70 °C) (-40 to 158 °F) Class 0.02 of nominal value (40 to 70 Hz) (15 to 30 °C) (59 to 86 °F)
Power measurements	Accuracy: Class 0.5
Accuracy and temperature	Unless otherwise specified for the above measurements: Nominal range: -40 to 70 °C (-40 to 158 °F) Reference range: 15 to 30 °C (59 to 86 °F) Accuracy: Measurement type specific within reference range Additional 0.2 % error of full scale per 10 °C (18 °F) outside reference range
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Secure the current measurement terminal block to the module faceplate: 0.25 N·m (2.2 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Terminal connections	AC voltage and current terminals: Standard 45º plugs, 2.5 mm^2 Wiring: 2.5 mm^2 (13 AWG), multi-stranded
Galvanic isolation	Between AC voltage and other I/Os: 3310 V, 50 Hz for 60 s Between AC current and other I/Os: 2210 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Accessories (included)	• One roundel with 6 J-shaped voltage encoding pins (for the hardware module) • One roundel with 6 flat voltage encoding pins (for the voltage terminal blocks)
Weight	232 g (0.5 lb)

3.3.4 Differential current module ACM3.2

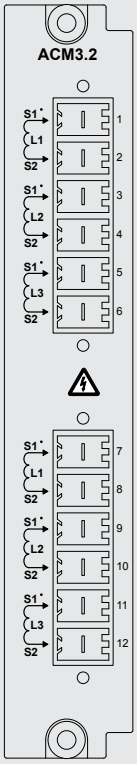
The differential current module ACM3.2 measures the generator outgoing 3-phase currents (consumer side) and star point 3-phase currents. The ACM3.2 uses the measurements to detect phase-to-phase faults or phase-to-earth faults (star point earthed generator stator only) in the generator stator, and dependent on the mounting of the CT's on the outgoing side, possibly also the cable between the generator and the main switchboard.

The protection consists of:

- A stabilised stage that uses a fixed + 2 × sloped operating characteristic. This current restraint approach is also known as biased differential protection.
- A high set fixed differential stage (non-stabilised).



ACM3.2 terminals

Module	Count	Symbol	Type	Name
	1 × (L1, L2 and L3)		Current	3-phase current measurement - Consumer side
	1 × (L1, L2 and L3)		Current	3-phase current measurement - Neutral side

ACM3.2 technical specifications

Category	Specification
Nominal, reference and operating values	Current: Nominal value: 1 or 5 A AC from current transformer Frequency: • Nominal value: 50 or 60 Hz • Reference range: 40 to 70 Hz • Operating range: 20 to 78 Hz Temperature: • Reference range: 15 to 30 °C (59 to 86 °F) • Operating range: -40 to 70 °C (-40 to 158 °F)
Current measurements	Measurement range: 0.025 to 250 A AC. Truncation level: 20 mA

Category	Specification
	Accuracy: • 0.025 to 20 A: ±1 % or ±10 mA of measured current (whichever is greater) • 20 to 250 A: ±1.5 % of measured current UL/cUL Listed: From listed or R/C (XODW2.8) current transformers 1 or 5 A Load on external current transformer: < 4 mΩ, including the terminal block Current withstand: • 20 A continuously • 100 A for 10 s • 400 A for 1 s • 1250 A for 10 ms (half wave)
Frequency measurement	Accuracy (within operating range): > 0.1 A: ±0.1 % of actual frequency
Temperature	Current measurement accuracy temperature coefficient: ±0.25 %, or ±2.5 mA per 10 °C (18 °F) outside reference range (whichever is greater)
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Secure the current measurement terminal block to the module faceplate: 0.25 N·m (2.2 lb-in) Connection of wiring to terminals: • ≤ 4 mm^2: 0.5 N·m (4.4 lb-in) to 0.6 N·m (5.3 lb-in) • > 4 mm^2: 0.7 N·m (6.2 lb-in) to 0.8 N·m (7.1 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Terminal connections	AC current terminals: Standard 0º plugs, 6 mm^2 with securing screws Wiring: 2.5 to 6 mm^2 (13 to 10 AWG), multi-stranded
Galvanic isolation	Between AC current and other I/Os: 2210 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 mm × 152 mm (1.1 × 6.4 × 5.9 in)
Weight	230 g (0.5 lb) (including terminal blocks)
Accessories (included)	One roundel with 6 encoding pins (for the hardware module and terminal block)

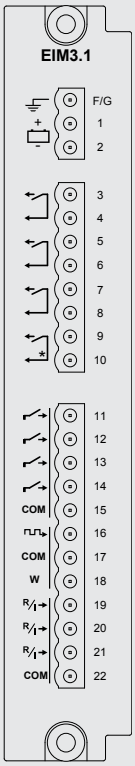
3.3.5 Engine interface module EIM3.1

The engine interface module has its own power supply and a tacho input to measure speed. It also has four relay outputs, four digital inputs, and three analogue inputs. These I/Os are configurable.

The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

EIM3.1 has its own microprocessor. If the rack power supply fails, or connection to the application is lost, the EIM3.1 can continue to operate independent of the application.

EIM3.1 terminals

Module	Count	Symbol	Type	Name
	1		Ground	Frame ground
	1		12 or 24 V DC	Power supply
	3		Relay output	Configurable
	1		Relay output (with wire break detection)	Configurable
	4		Digital input	Configurable
	1		MPU input (with wire break detection)*	Magnetic pickup
	1	W	W input (no wire break detection)*	Generator tacho output or NPN/PNP sensor
	3	R/I	Analogue current or resistance measurement input (RMI)	Configurable

NOTE *These inputs cannot both be used at the same time.

EIM3.1 technical specifications

Category	Specification
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Auxiliary power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 3 W, maximum 5 W Internal protection: by 12 A fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter ◦ 24 V: 0.6 A minimum ◦ 12 V: 1.2 A minimum • Battery: No limit
Relay outputs	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 30 V DC and 6 A, resistive Voltage withstand: ±36 V DC
Relay output with wire break detection	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 30 V DC and 6 A, resistive Includes wire break detection Voltage withstand: ±36 V DC
Magnetic pickup	Voltage: 3 to 70 V AC peak Frequency: 2 to 20,000 Hz Accuracy: 2 to 99 Hz: 0.5 Hz; 100 to 20,000 Hz: ±0.5 % of measurement

Category	Specification
	Cable supervision: Resistance maximum 100 kΩ Includes wire break detection Voltage withstand: 70 V AC
Generator tacho (W) **w**	Voltage: 8 to 36 V DC Frequency: 2 to 20,000 Hz Accuracy: 2 to 99 Hz: 0.5 Hz; 100 to 20,000 Hz: ±0.5 % of measurement No wire break detection Voltage withstand: ±36 V DC
NPN/PNP **w**	Voltage: 8 to 36 V DC Frequency: 2 to 20,000 Hz Accuracy: 2 to 99 Hz: 0.5 Hz; 100 to 20,000 Hz: ±0.5 % of measurement No wire break detection Voltage withstand: ±36 V DC
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Analogue multi-functional inputs	**Current input** • From active transmitter: 0 to 20 mA, 4 to 20 mA, or any custom range between 0 and 25 mA • Accuracy: 1 % of selected range **Pt100/1000** • -40 to 250 °C (-40 to 482 °F) • Accuracy: 1 % of full scale (to IEC/EN60751) • Maximum sensor self-heating: 0.5 °C/mW (1 °F/mW) **Resistance measurement** • Any custom range between 0 and 2.5 kΩ • Accuracy: 1 % over ranges: 0 to 200 Ω, 0 to 300 Ω, 0 to 500 Ω, 0 to 1000 Ω, and 0 to 2500 Ω **Digital input** • Dry contact with cable supervision • Maximum circuit resistance: 330 Ω • Minimum current rating for the connected relay: 2.5 mA Voltage withstand: ±36 V DC All analogue multi-functional inputs for EIM3.1 have a common ground
Terminal connections	**Frame ground and power supply** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between relay groups and other I/Os: 600 V, 50 Hz for 60 s Between digital input groups and other I/Os: 600 V, 50 Hz for 60 s Between MPU and W inputs and other I/Os: 600 V, 50 Hz for 60 s Between analogue inputs and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529

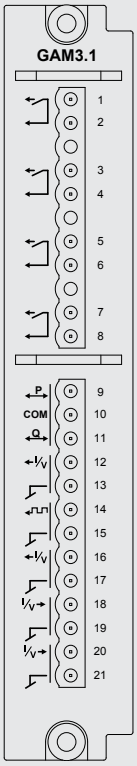
Category	Specification
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	250 g (0.5 lb)

3.3.6 Governor and AVR module GAM3.1

This governor and AVR module has four relay outputs, two analogue outputs and a pulse width modulation output, and two analogue inputs. These I/Os are configurable.

GAM3.1 also has terminals for analogue load sharing (future use).

GAM3.1 terminals

Module	Count	Symbol	Type	Name
	4		Relay output	Configurable
	1	P	Load sharing	Active power (P) (kW) load sharing (future use)
	1	Q	Load sharing	Reactive power (Q) (kvar) sharing (future use)
	2	I/V	Analogue current or voltage output	GOV/AVR/configurable
	1		Pulse width modulation (PWM) output	PWM output (with PWM ground)
	2	I/V	Analogue current or voltage input	Configurable

GAM3.1 technical specifications

Category	Specification
Relay outputs	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 250 V AC or 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Altitude derating from 2,000 to 4,000 m (6,562 to 13,123 ft): Maximum 150 V AC phase-to-phase Voltage withstand: 250 V AC
Load sharing (future use)	Voltage input/output: -5 to 5 V DC Impedance: 23.5 kΩ Accuracy: 1 % of full scale, for both inputs and outputs Voltage withstand: ±36 V DC
Analogue multi-functional outputs	**Current output** • -20 to 20 mA, or 0 to 20 mA, or 4 to 20 mA, or any custom range between -25 and 25 mA • Accuracy: 1 % of the selected range (minimum range: 5 mA) • 16-bit resolution over the range -25 to 25 mA

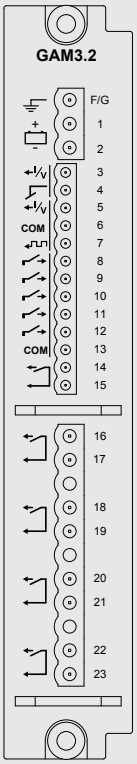
Category	Specification
	• Active output (internal supply) • Maximum load: 400 Ω **Voltage output (DC)** • -10 to 10 V, 0 to 10 V, 0 to 5 V, -5 to 5 V, 0 to 3 V, -3 to 3 V, or 0 to 1 V, or any custom range between -10 and 10 V • Accuracy: 1 % of the selected range (minimum range: 1 V) • 16-bit resolution over the range -10 to 10 V • Minimum load: 600 Ω. Voltage output internal resistance: < 1 Ω Voltage withstand: ±36 V DC Controller power off: Internal resistance > 10 MΩ
Pulse width modulation (PWM) output	Frequency: 500 Hz ±50 Hz Resolution: 43,200 levels Voltage: • Low level: < 0.5 V • High level: > 5.5 V • Maximum: 6.85 V Output impedance: 100 Ω Nominal temperature range: -40 to 70 °C (-40 to 158 °F) Reference temperature range: 15 to 30 °C (59 to 86 °F) Duty cycle accuracy (5 to 95 %): 0.25 % within reference temperature range 0.2 % of full scale additional error per 10 °C (18 °F) outside the reference range Example: At 70 °C (158 °F) the accuracy of the PWM output is 0.25 % + 4 × 0.2 % = 1.05 % Voltage withstand: ±30 V DC
Analogue multi-functional inputs	**Current inputs** • From active transmitter: 0 to 20 mA, 4 to 20 mA, or any custom range between 0 and 24 mA • Accuracy: 1 % of selected range **Voltage inputs (DC)** • -10 to 10 V, 0 to 10 V, or any custom range between -10 and 10 V • Accuracy: 1 % of selected range Voltage withstand: ±36 V DC
Terminal connections	Terminals: Standard 45° plug, 2.5 mm^2 Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between individual relays and other I/Os: 2210 V, 50 Hz for 60 s Between load sharing and other I/Os: 600 V, 50 Hz for 60 s Between terminals 12 to 15 (analogue output 1, PWM output), and other I/Os: 600 V, 50 Hz for 60 s • Analogue output 1 and the PWM output are galvanically connected Between terminals 16, 17 (analogue output 2) and other I/Os: 600 V, 50 Hz for 60 s Between terminals 18 to 21 (analogue inputs) and other I/Os: 600 V, 50 Hz for 60 s • Analogue inputs 1 and 2 are galvanically connected
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	224 g (0.5 lb)

3.3.7 Governor and AVR module GAM3.2

This governor and AVR module has its own power supply, two analogue outputs and a pulse width modulation output, five digital inputs, a status relay output, and four relay outputs. Apart from the status relay, all these I/Os are configurable.

GAM3.2 has its own microprocessor. If the rack power supply fails, GAM3.2 can continue to be used for manual operation if it has its own, independent power supply. The power supply terminals include circuit protection against load dump transients and JEM177 surge transients (rugged design). These terminals also include battery voltage measurement.

GAM3.2 terminals

Module	Count	Symbol	Type	Name
	1		Ground	Frame ground
	1		12 or 24 V	Power supply
	2		Analogue current or voltage output	GOV/AVR/configurable
	1		Pulse width modulation (PWM) output	PWM output
	5		Digital input	Configurable
	1		Relay output	GAM3.2 status
	4		Relay output	Configurable

GAM3.2 technical specifications

Category	Specification
Auxiliary power supply	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 3 W, maximum 5 W Voltage measurement accuracy: ±0.1 V (measurement range 8 to 36 V DC) Internally protection: 12 A fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter ◦ 24 V: 0.6 A minimum ◦ 12 V: 1.2 A minimum • Battery: No limit
Analogue multi-functional outputs	**Current output** • Any custom range between -25 and 25 mA • Accuracy: 1 % of the selected range (minimum range: 5 mA)

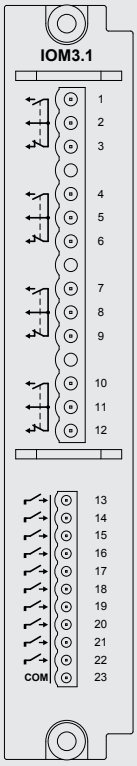
Category	Specification
	• 16-bit resolution • Active output (internal supply) • Maximum load: 400 Ω **Voltage output (DC)** • Any custom range between -10 and 10 V • Accuracy: 1 % of the selected range (minimum range: 1 V) • 16-bit resolution • Minimum load: 600 Ω. Voltage output internal resistance: < 1 Ω. Voltage withstand: ±36 V DC Controller power off: Internal resistance > 10 MΩ
Pulse width modulation (PWM) output	Frequency: 500 Hz ±50 Hz Resolution: 43,200 levels Voltage: • Low level: < 0.5 V • High level: > 5.5 V • Maximum: 6.85 V Output impedance: 100 Ω Nominal temperature range: -40 to 70 °C (-40 to 158 °F) Reference temperature range: 15 to 30 °C (59 to 86 °F) Duty cycle accuracy (5 to 95 %): 0.25 % within reference temperature range 0.2 % of full scale additional error per 10 °C (18 °F) outside the reference range Example: At 70 °C (158 °F) the accuracy of the PWM output is 0.25 % + 4 × 0.2 % = 1.05 % Voltage withstand: ±30 V DC
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Relay output (GAM3.2 status)	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Relay outputs	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 250 V AC or 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Altitude derating from 2,000 to 4,000 m (6,562 to 13,123 ft): Maximum 150 V AC phase-to-phase Voltage withstand: 250 V AC
Terminal connections	**Frame ground and power supply** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Analogue inputs, PWM, digital inputs and the status relay** • Terminals: Standard 45° plug, 1.5 mm^2 • Wiring: 0.5 to 1.5 mm^2 (28 to 16 AWG), multi-stranded **Relay outputs** • Terminals: Standard 45° plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to frame ground and power supply terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to analogue inputs, PWM, digital inputs, and the status relay terminals: 0.25 N·m (2.2 lb-in)

Category	Specification
	Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply and other I/Os: 600 V, 50 Hz for 60 s Between analogue inputs, PWM, digital inputs, and the status relay, and other I/Os: 600 V, 50 Hz for 60 s The analogue output on terminals 5 and 6 is galvanically connected to the PWM output (terminals 6 and 7) Between relay groups and other I/Os: 2210 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	246 g (0.5 lb)

3.3.8 Input/output module IOM3.1

The input output module has 4 changeover relay outputs, and 10 digital inputs. These I/Os are all configurable.

IOM3.1 terminals

Module	Count	Symbol	Type	Name
	4		Relay output	Configurable
	10		Digital input	Configurable

IOM3.1 technical specifications

Category	Specification
Relay outputs 	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 250 V AC or 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Altitude derating from 3,000 to 4,000 m (9,842 to 13,123 ft): Maximum 150 V AC phase-to-phase Voltage withstand: 250 V AC
Digital inputs 	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms

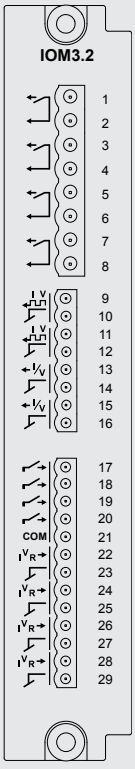
Category	Specification
	Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Terminal connections	**Relay outputs**: Terminals: Standard 45° plug, 2.5 mm^2 Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded **Digital inputs**: Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to digital input terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 ºC (194 °F) copper conductors only
Galvanic isolation	Between relay groups and other I/Os: 2210 V, 50 Hz for 60 s Between digital input groups and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	196 g (0.4 lb)

3.3.9 Input/output module IOM3.2

The input output module has 4 relay outputs, 4 analogue multifunctional outputs (including 2 pulse width modulation PWM outputs), 4 digital inputs, and 4 analogue multifunctional inputs. These I/Os are all configurable.

Internal cold junction compensation is not available on IOM3.2

IOM3.2 terminals

Module	Count	Symbol	Type	Name
	4		Relay output	Configurable
	2	I V	Analogue multifunctional output (mA, V DC, PWM)	Configurable
	2	I/V	Analogue multifunctional output (mA, V DC)	Configurable
	4		Digital input	Configurable
	4	I V R	Analogue multifunctional input (mA, V DC, RMI)	Configurable

IOM3.2 technical specifications

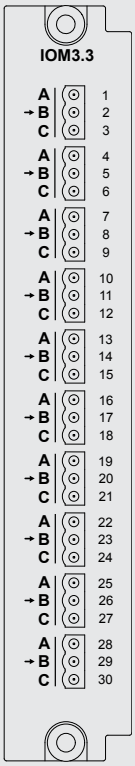
Category	Specification
Relay outputs	Relay type: Solidestate relay Electrical rating and UL/cUL Listed: 30 V DC, and 6 A, resistive; B300, pilot duty (B300 is a power limit specification for inductive loads) Voltage withstand: ±36 V DC
Analogue multifunctional outputs	**Current output:** • Range: Any custom range between -25 to 25 mA DC • Accuracy: 1 % of range • Resolution: 16 bits (< 2 uA / bit) • Type: Active output (internal supply) • Load: Maximum ±25 mA -> 400 Ω **Voltage output:** • Range: Any custom range between -10 to 10 V DC • Accuracy: 1 % of range • Resolution: 16 bits (< 0,7 mV / bit) • Load: Minimum ±10V -> 600 Ω • Internal resistance, power ON: < 1 Ω • Internal resistance, power OFF: > 10 MΩ **General information for all outputs:** • Refresh rate (max): 50ms (input to output) • Voltage withstand: ±36 V DC
Analogue multifunctional PWM outputs	**PWM output:** • Frequency range: 1 to 2500 Hz ±5 Hz • Duty cycle accuracy (5 to 95 %): 0.5 % within reference temperature range • Resolution: 12 bits (4096 steps) • Voltage: Low level: < 0.5 V. High level: > adjustable 1 to 10 V. Maximum: 10.2 V • Output impedance: 25 Ω **General information for all outputs:** • Refresh rate (max): 50 ms (input to output) • Voltage withstand: ±36 V DC
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 3.9 kΩ Voltage withstand: ±36 V DC
Analogue multifunctional inputs	**Digital inputs with wire break detection:** • Dry contact inputs, 3 V DC internal supply • Wire-break detection with maximum resistance for ON detection: 100 Ω to 400 Ω **Current inputs:** • From active transmitter: 0 to 20 mA, or 4 to 20 mA • Accuracy: ±10 uA ±0.25 % of actual reading **Voltage inputs (DC):** • Range: ±10 V DC / 0 to 10 V DC • Accuracy: ±10 mV ±0.25 % of actual reading **Resistance measurement inputs, 2 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±1 Ω ±0.25 % of actual reading

Category	Specification
	Resistance measurement inputs, 1 wire (RMI): • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±2 Ω ±0.25 % of actual reading **Pt100:** • Range: -200 to 850 °C • Accuracy: ±1 °C ±0.25 % of actual reading **Pt1000:** • Range: -200 to 850 °C • Accuracy: ±0.5 °C ±0.25 % of actual reading **Thermocouple type, range and accuracy:** • E: -200 to 1000 °C (±2 °C ±0.25 % of actual reading) • J: -210 to 1200 °C (±2 °C ±0.25 % of actual reading) • K: -200 to 1372 °C (±2 °C ±0.25 % of actual reading) • N: -200 to 1300 °C (±2 °C ±0.25 % of actual reading) • R: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • S: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • T: -200 to 400 °C (±2 °C ±0.25 % of actual reading) **Note:** Twisted pair and shielded cable is recommended to achieve specification and optimisation of noise immunity. **General information for all outputs:** • Refresh rate (max): 50 ms (input to output) • Voltage withstand: ±36 V DC • All analogue multi-functional inputs have a common ground
Terminal connections	**Relay outputs**: Terminals: Standard 45° plug, 2.5 mm^2 Wiring: 0.5 to 2.5 mm^2 (22 to 14 AWG), multi-stranded **Other inputs**: Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to digital input terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 ºC (194 °F) copper conductors only
Galvanic isolation	Between relay groups and other I/Os: 2210 V, 50 Hz for 60 s Between other input groups and other I/Os: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	188 g (0.4 lb)

3.3.10 Input/output module IOM3.3

The input output module has 10 analogue multifunctional inputs. These I/Os are all configurable.

IOM3.3 terminals

Module	Count	Symbol	Type	Name
	10	A →B C	Analogue multifunctional inputs (mA, V DC, RMI)	Configurable

IOM3.3 technical specifications

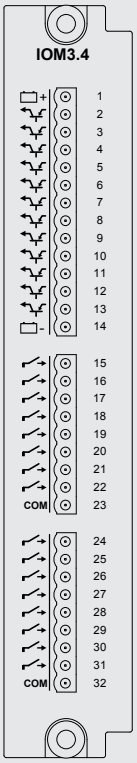
Category	Specification
Analogue multifunctional inputs A →B C	**Digital inputs with wire break detection:** • Dry contact inputs, 3 V DC internal supply • Wire-break detection with maximum resistance for ON detection: 100 Ω to 400 Ω **Current inputs:** • From active transmitter: 0 to 20 mA, or 4 to 20 mA • Accuracy: ±10 uA ±0.25 % of actual reading **Voltage inputs (DC):** • Range: ±10 V DC / 0 to 10 V DC • Accuracy: ±10 mA ±0.25 % of actual reading **Resistance measurement inputs, 2 or 3 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±1 Ω ±0.25 % of actual reading * **Resistance measurement inputs, 1 wire (RMI):** • Resistance measurement: 0 to 4.5 kΩ • Accuracy: ±2 Ω ±0.25 % of actual reading **Pt100:** • Range: -200 to 850 °C • Accuracy: ±1 °C ±0.25 % of actual reading **Pt1000:** • Range: -200 to 850 °C • Accuracy: ±0.5 °C ±0.25 % of actual reading **Thermocouple type, range and accuracy:** • E: -200 to 1000 °C (±2 °C ±0.25 % of actual reading) • J: -210 to 1200 °C (±2 °C ±0.25 % of actual reading)

Category	Specification
	• K: -200 to 1372 °C (±2 °C ±0.25 % of actual reading) • N: -200 to 1300 °C (±2 °C ±0.25 % of actual reading) • R: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • S: -50 to 1768 °C (±2 °C ±0.25 % of actual reading) • T: -200 to 400 °C (±2 °C ±0.25 % of actual reading) **Note:** Twisted pair and shielded cable is recommended to achieve specification and optimisation of noise immunity. **General information for all inputs:** • Voltage withstand: ±36 V DC
Internal cold junction compensation (CJC)	**Internal temperature sensor:** • Range: 0 to 70 °C ◦ Accuracy: ±1.0 °C • Range: -40 to 0 °C ◦ Accuracy: ±2.0 °C **Mathematical compensation:** • If non channels are configured as 4-20 mA ◦ Accuracy: ±1.0 °C • If any channels are configured as 4-20 mA ◦ Accuracy: ±1.5 °C If it is needed to have 4-20 mA channels on the same card, it is recommended to use the top channels for 4-20 mA and the lower channels for TC's **Internal cold junction accuracy:** • Heat dissipated by nearby heat sources can cause errors in thermocouple measurements by heating the IOM3.3 terminals to a different temperature than the cold-junction compensation sensor. Thermal gradient across the terminals can cause the terminals of different IOM3.3 channels to be at different temperatures, which creates accuracy errors and affects the relative accuracy between channels. • The temperature measurement accuracy specifications include errors caused by the thermal gradient across the IOM3.3 terminals for configurations with the IOM3.3 terminals facing forward or upward.
Terminal connections	Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to relay output terminals: 0.5 N·m (4.4 lb-in) Connection of wiring to input terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 ºC (194 °F) copper conductors only
Galvanic isolation	All 10 multi inputs have a common ground Galvanic isolation from rack: 600 V, 50 Hz for 60 s
Dimensions	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	164 g (0.4 lb)

3.3.11 Input/output module IOM3.4

The input output module has 12 digital outputs, and 16 digital inputs. These I/Os are all configurable.

IOM3.4 terminals

Module	Count	Symbol	Type	Name
	12		Digital output	Configurable
	16		Digital input	Configurable

IOM3.4 technical specifications

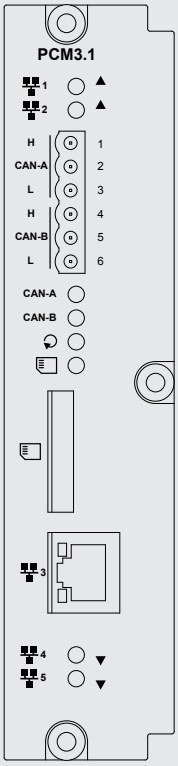
Category	Specification
Digital outputs	Transistor type: PNP Supply voltage: 12 or 24 V DC nominal, maximum 36 V DC (relative to common) Maximum current (per output): < 55 °C: 250 mA; > 55 °C: 200 mA Leak current: Typical 1 µA, maximum 100 µA (temperature-dependent) Saturation voltage: Maximum 0.5 V Non-replaceable 4 A fuse Voltage withstand: ±36 V DC Load dump protected by TVS diodes Short circuit protection Reverse polarity protection Internal freewheeling diode
Digital inputs	Bipolar inputs • ON: -36 to -8 V DC, and 8 to 36 V DC • OFF: -2 to 2 V DC Minimum pulse length: 50 ms Impedance: 4.7 kΩ Voltage withstand: ±36 V DC
Terminal connections	Terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.1 to 1.5 mm^2 (28 to 16 AWG), multi-stranded
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.25 N·m (2.2 lb-in) UL/cUL Listed: Wiring must be minimum 90 ºC (194 °F) copper conductors only
Galvanic isolation	Between groups: 600 V, 50 Hz for 60 s
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529

Category	Specification
Size	L×H×D: 28 × 162 × 150 mm (1.1 × 6.4 × 5.9 in)
Weight	175 g (0.4 lb)

3.3.12 Processor and communication module PCM3.1

The processor and communication module has the controller's main microprocessor, which contains and runs the controller application software. It includes the Ethernet switch to manage the controller Ethernet connections, with five 100BASE-TX Ethernet connections. It has a *Self-check OK* LED. It also has two sets of CAN bus terminals and SD card. The PCM3.1 performs time synchronisation with an NTP server.

PCM3.1 terminals

Module	Count	Symbol	LED	Type	Name
	5		**Off** : No communication **Green** : Communication connected **Green flash** : Active communication	Ethernet (RJ45)	External network and DEIF network LEDs on the front of the hardware module. Two connections at the top of the hardware module, one on the front, and two at the bottom.
	2	H, CAN-A, L H, CAN-B, L	**Off** : No communication **Green** : CAN connected **Green flash** : Active CAN communication	CAN bus connection	CAN bus
	1		**Off** : Self-check not OK **Green** : Self-check OK **Green flash** : In service mode		
	1		**Off** : No access **Green flash** : Read or write to SD card	SD card (industrial grade) *	External memory

NOTE * To meet the temperature and EMC specifications, you must use an industrial grade SD card.

PCM3.1 technical specifications

Category	Specification
CAN terminals	Voltage withstand: ±24 V DC
Galvanic isolation	Between CAN A and other I/Os: 600 V, 50 Hz for 60 s Between CAN B and other I/Os: 600 V, 50 Hz for 60 s Between Ethernet ports and other I/Os: 600 V, 50 Hz for 60 s
Battery	RENATA CR2430 3V industrial grade lithium battery: Rated for operation at -40 to 85 °C (-40 to 185 °F) Capacity: 285 mAh The battery can be replaced. This is **Not** a standard CR2430 battery, it has a higher capacity, improved temperature range, and extended lifetime.

Category	Specification
Battery life	Design life of the timekeeping battery is 10 years with no power to the controller. This is reduced if the ambient temperature is over 40 °C (104 °F).
Communication connections	CAN communication terminals: Standard 45° plug, 1.5 mm^2 Wiring: 0.5 to 1.5 mm^2 (28 to 16 AWG), multi-stranded DEIF network: RJ45. Use an Ethernet cable that meets or exceeds the SF/UTP CAT5e specifications. 100BASE-TX.
Torques and terminals	Module faceplate screws: 0.5 N·m (4.4 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Processor	400 MHz 32-bit PowerPC CPU
Memory	256 MB
Storage	512 MB
Ingress protection	Unmounted: No protection rating Mounted in rack: IP20 according to IEC/EN 60529
Dimensions	L×H×D: 36.8 × 162 × 150 mm (1.4 × 6.4 × 5.9 in)
Weight	214 g (0.5 lb)

3.3.13 Blind module

A blind module must be used to close off each empty slot in the rack.

Blind module technical specifications

Category	Specification
Tightening torque	Module faceplate screws: 0.5 N·m (4.4 lb-in)
Size	L×H×D: 28 × 162 × 18 mm (1.1 × 6.4 × 0.7 in)
Weight	44 g (0.1 lb)

3.4 Display unit DU 300 specifications

3.4.1 Display unit DU 300

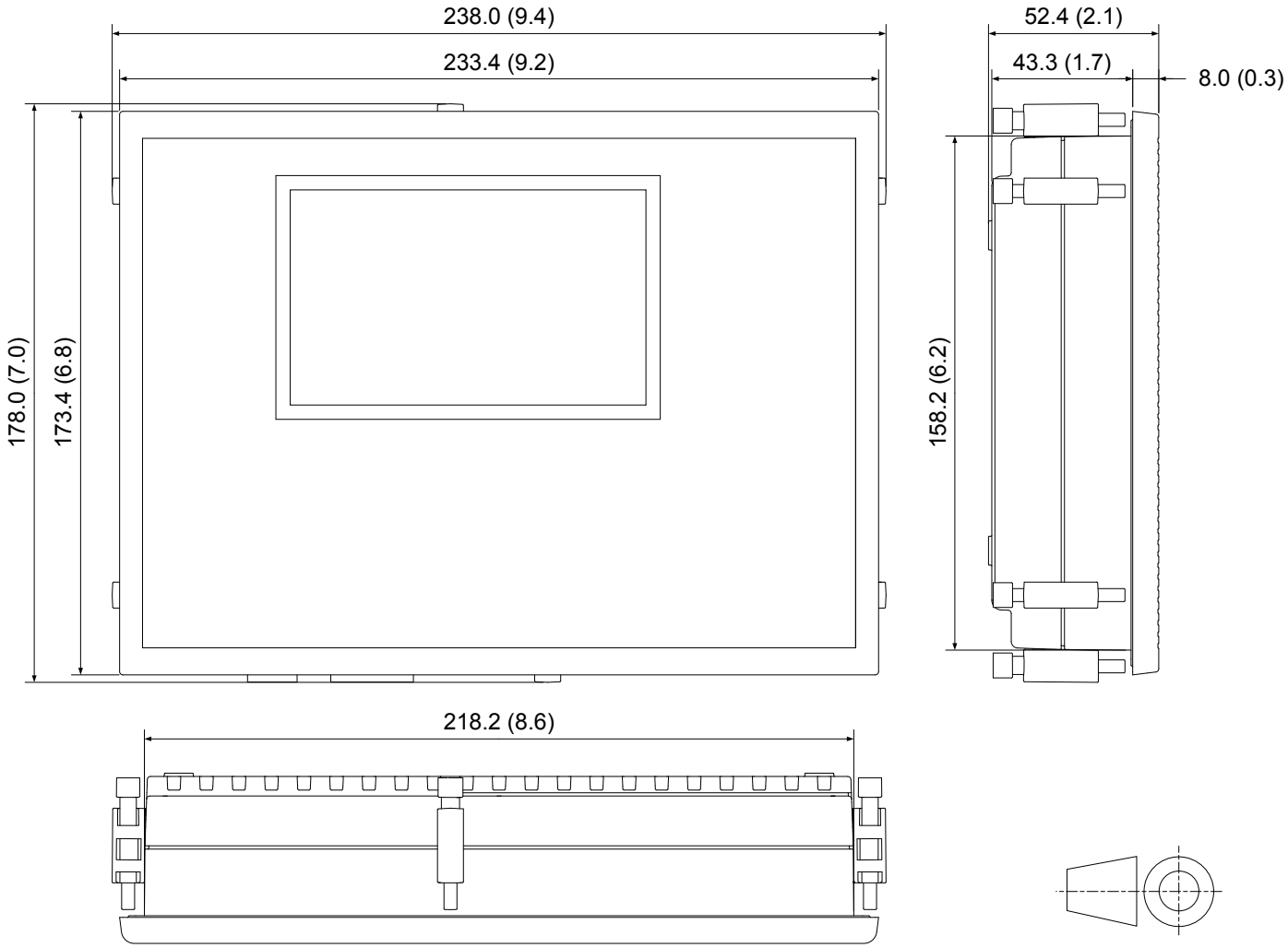
DU 300 technical specifications

Category	Specifications
Ingress protection	From the front: IP65 according to IEC/EN 60529 From the back: IP20 according to IEC/EN 60529
UL/cUL Listed	Type Complete Device, Open Type 1
Frame ground	Voltage withstand: ±36 V DC to the power supply positive (terminal 1) and negative (terminal 2)
Power supply + -	Input voltage: 12 or 24 V DC nominal (8 to 36 V DC continuously) UL/cUL Listed: 10 to 32.5 V DC 0 V DC for 50 ms when coming from at least 8 V DC (cranking dropout) Consumption: Typical 4 W, maximum 12 W Internal protection: 12 A slow-blow fuse (not replaceable) (fuse size determined by load dump requirements) Voltage withstand: ±36 V DC Load dump protected by TVS diodes **Start current** • Power supply current limiter

Category	Specifications
	◦ 24 V: 2.1 A minimum ◦ 12 V: 4.2 A minimum • Battery: No limit
Relay output 	Relay type: Electromechanical Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Relay output 	Relay type: Solid state Electrical rating and UL/cUL Listed: 30 V DC and 1 A, resistive Voltage withstand: ±36 V DC
Terminal connections	**Frame ground and power supply**: • Terminals: Standard plug, 2.5 mm^2 • Wiring: 1.5 to 2.5 mm^2 (16 to 12 AWG), multi-stranded **Other connections**: • Terminals: Standard plug, 2.5 mm^2 • Wiring: 0.5 to 2.5 mm^2 (22 to 12 AWG), multi-stranded
Communication connections	DEIF network: RJ45. Use an Ethernet cable that meets or exceeds the SF/UTP CAT5e specifications, 100BASE-TX
Torques and terminals	Display unit fixing screw clamps: 0.15 N·m (1.3 lb-in) Connection of wiring to terminals: 0.5 N·m (4.4 lb-in) UL/cUL Listed: Wiring must be minimum 90 °C (194 °F) copper conductors only
Galvanic isolation	Between power supply, relay groups, and network plugs: 600 V, 50 Hz for 60 s
Dimensions	L×H×D: 235 × 175 × 52 mm (9.3 × 6.9 × 2.0 in) (outer frame) Panel cutout, L×H: 220 × 160 mm (8.7 × 6.3 in)
Weight	835 g (1.8 lb)

DU 300 dimension and weight specifications

Category	Specifications
Dimensions	L×H×D: 235 × 175 × 52 mm (9.3 × 6.9 × 2.0 in) (outer frame) Panel cutout, L×H: 220 × 160 mm (8.7 × 6.3 in)
Weight	835 g (1.8 lb)



3.5 Accessory specifications

3.5.1 Ethernet cable

The Ethernet cable connects the display unit to the controller, or connects controllers to one another. The Ethernet cable from DEIF meets the technical specifications below.

Category	Specification
Cable type	Shielded patch cable SF/UTP CAT5e
Temperature	Fixed installation: -40 to 80 ºC (-40 to 176 °F) Flexible installation: -20 to 80 ºC (-4 to 176 °F)
Minimum bending radius (recommended)	Fixed installation: 25.6 mm (1.01 in) Flexible installation: 51.2 mm (2.02 in)
Length	2 m (6.6 ft)
Weight	~110 g (4 oz)

4. Ordering

4.1 PPU 300 controller ordering

Controller hardware configuration, standard controller

Each controller is supplied with a PSM3.1, ACM3.1 and PCM3.1 module.

A display unit can be ordered directly along with the controller (see type selection in table 4.3).

Standard controller without CODESYS

The standard controller can via display or PC software PICUS be selected to be one of the following types:

- Diesel generator controller.
- Shaft generator controller.
- Bus tie breaker controller.
- Shore connection controller.

Rack size: 7-slot **Item number**: 2912210060.01

Rack size: 4-slot **Item number**: 2912210060.07

Standard controller with CODESYS

Rack size: 7-slot **Item number**: 2912210060.06

Rack size: 4-slot **Item number**: 2912210060.09

Table 4.1 Controller configuration, standard controller, with or without CODESYS

Rack	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
R7.1	PSM3.1	ACM3.1	Selectable	Selectable	Selectable	Selectable	PCM3.1
R4.1	PSM3.1	ACM3.1	Selectable	PCM3.1	N/A	N/A	N/A

Controller Hardware, Hybrid controller

The Hybrid controller can be used as a battery bank (ESS, Energy Storage System) controller, controlling the battery inverter.

A display unit can be ordered along with the controller (see type selection in table 4.3).

Rack size: 7-slot **Item number**: 2912210060.13

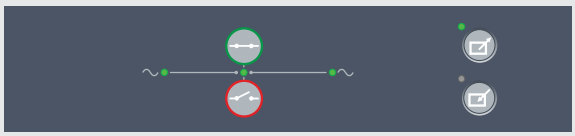
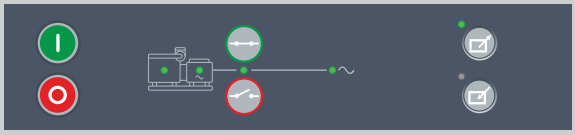
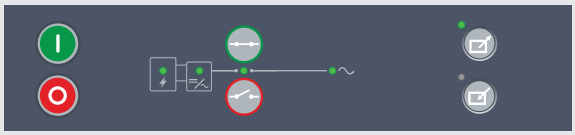
Table 4.2 Controller configuration, Hybrid controller

Rack	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
R7.1	PSM3.1	ACM3.1	IOM3.1	GAM3.1	Selectable	Selectable	PCM3.1

Display unit selection

These selections are for standard unit displays. The Hybrid controller display always comes with the Hybrid folio.

Table 4.3 Display unit selection

Options	Folio *	Notes
Blank		Blank display unit folio. Used for: Read data only, no breaker feedback, no control.
CB w/o CTRL		Display unit folio with application LEDs. Used for: Read data and see status and position, no control.
CB CTRL		Display unit folio with breaker push-buttons. Used for: • Shaft generator control. • Bus tie breaker control. • Shore connection control.
DG + CB CTRL		Display unit folio with full functionality. Used for: Generator control.
HYBRID		Display unit folio with full functionality. Used for: Inverter control.

NOTE * Only bottom part of display is shown, the top part is always the same.

4.2 Extension rack ordering

The Extension rack comes as standard with PSM3.2 module mounted.

Extension rack configuration

Rack size: 7-slot or 4-slot

Item number: 2912990350.01

Table 4.4 Extension rack configuration

Rack	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
R7.1	PSM3.2	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
R4.1	PSM3.2	Selectable	Selectable	Selectable	N/A	N/A	N/A

4.3 Modules for controller configuration

The following table lists accessories/spare parts for a PPU 300 controller.

Table 4.5 Accessories or spare parts order

Module	Terminals	Comment	Item no.	Options
DU 300	-	Display unit for PPU 300.	2912990240.01	Blank
				CB w/o CTRL
				CB CTRL
				DG + CB CTRL
				HYBRID
R7.1	-	7-slot rack for use as controller or extension rack.	2912990240.09	-
R4.1	-	4-slot rack for use as controller or extension rack.	2912990240.41	-
PSM3.1	**Power Supply Module (main rack)** • 1 × Power supply • 3 × Relay outputs (2 x configurable) • 2 × RJ45 EtherCAT communication ports	For use in controller rack.	2912990240.07	-
PSM3.2	**Power Supply Module (extension rack)** • 1 × Power supply • 3 × Relay outputs (2 x configurable) • 2 × RJ45 EtherCAT communication ports	For use in extension racks.	2912990240.42	-
ACM3.1	**AC voltage and current module** • 2 × 3-phase voltage measurements • 1 × 3-phase and 4th current measurements	A maximum of one ACM3.1 module is allowed per controller (including extension racks).	2912990240.03	-
ACM3.2	**Differential current module** • 1 x 3-phase current measurement - Consumer side • 1 x 3-phase current measurement - Neutral side	A maximum of one ACM3.2 module is allowed per controller (including extension racks).	2912990240.40	-
IOM3.1	**Input Output Module** • 4 × Changeover relays • 10 × Digital inputs		2912990240.05	-
IOM3.2	**Input Output Module** • 4 × Relay outputs • 2 × Analogue multifunctional outputs (mA, V DC, PWM) • 2 × Analogue multifunctional outputs (mA, V DC) • 4 x Digital inputs • 4 x Analogue multifunctional inputs (mA, V DC, RMI)		2912990240.44	-
IOM3.3	**Input Output Module** • 10 x Analogue multifunctional inputs (mA, V DC, RMI)		2912990240.45	-
IOM3.4	**Input Output Module** • 12 × Transistor outputs • 16 × Digital inputs		2912990240.25	-

Module	Terminals	Comment	Item no.	Options
EIM3.1	**Engine Interface Module** • 1 × Power supply • 4 × Relay outputs (1 with wire break detection) • 4 × Digital inputs • 1 × MPU input • 1 × W input • 3 × Current/resistance analogue inputs	A maximum of three EIM3.1 modules are allowed per controller (including extension units).	2912990240.04	-
GAM3.1	**Governor and AVR Module** • 4 × Relay outputs • 2 × Current/voltage analogue outputs • 1 × PWM output • 2 × Current/voltage analogue inputs	A maximum of three GAM3.1 and/or GAM3.2 modules are allowed per controller (including extension units).	2912990240.06	-
GAM3.2	**Governor and AVR Module** • 1 × Power supply • 2 × Current/voltage analogue outputs • 1 × PWM output • 5 × Digital inputs • 5 × Relay outputs	A maximum of three GAM3.1 and/or GAM3.2 modules are allowed per controller (including extension units).	2912990240.26	-
PCM3.1	**Processor and Communication Module** • 5 × Ethernet communication ports • 2 × CAN bus connections • 1 × SD card slot		2912990240.46	-
Blind	Blind module	Not allowed between PSM3.1 and the optional modules.	2912990240.08	-
Blind small	Small blind module	One needed for extension rack	2912990240.43	-
Shielded patch cable	-	SF/UTP CAT5e	2912990240.14	-
Terminal blocks	Terminal blocks for Multi-line 300		2912990240.38	-

5. Legal information

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